

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE HONORABLE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the Application of

Masayuki KAMON et al.

Application No.: 10/689,995

Examiner: J. PILKINGTON

Filed: October 22, 2003

Docket No.: 117589

For: ARTICULATED MANIPULATOR

BRIEF ON APPEAL

Appeal from Group 3682

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I. REAL PARTY IN INTEREST

The real party in interest for this appeal and the present application is Toyota Jidosha Kabushiki Kaisha and Kawasaki Jukogyo Kabushiki Kaisha, by way of an Assignment recorded in the U.S. Patent and Trademark Office at Reel 020880, Frame 0244.

II. RELATED APPEALS AND INTERFERENCES

There are no prior or pending appeals, interferences or judicial proceedings, known to Appellant, Appellant's representative, or the Assignee, that may be related to, or that will directly affect or be directly affected by or have a bearing upon, the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 8-10 are on appeal.

Claims 8-10 are pending.

Claims 8-10 are rejected.

Claims 1-7 are canceled.

IV. STATUS OF AMENDMENTS

An Amendment After Final Rejection was filed simultaneously herewith to amend informalities in claims 8 and 9. The status of entry of the Amendment After Final Rejection is not yet known, but should be entered as the claim amendments are directed to matters of form only. This Appeal Brief thus presents the claims as amended in the Amendment After Final Rejection.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The disclosure of claim 8 is directed to an articulated manipulator comprising:

a base (see Figure 1, reference 21);

first to sixth links arranged in series on the base (see Figure 1, references c1-c6); and

a plurality of joints rotatably connecting the base and the first link, and the two adjacent links out of the first to sixth links (see Figure 1, references d1-d6),

wherein the joints include first and second coaxial joints and first to fourth diagonal joints (see Figure 1 and page 14, lines 3-19),

the first link is connected to a base by the first coaxial joint for rotation about a rotation axis coaxial with an axis of the first link (see Figure 1, references d1, c1 and 21 and page 14, lines 25-29),

the first link and the second link are connected to each other by the first diagonal joint for rotation about a rotation axis inclined at an angle of 45 degrees relative to the first axis of the first link (see Figure 1, references c1, c2 and d2 and page 14, lines 30-35),

the second link and the third link are connected to each other by the second diagonal joint for rotation about a rotation axis inclined at an angle of 45 degrees relative to the axis of the second link (see Figure 1, references c2, c3 and d3 and page 14, line 35-page 15, line 6),

the rotation axis being parallel to the rotation axes of the first and second links (see Figure 1, reference L3 and page 15, lines 6-10),

the third link and the fourth link are connected to each other by the third diagonal joint for rotation about a rotation axis inclined at an angle of 45 degrees relative to the axis of the third link (see Figure 1, references c3, c4 and d4 and page 15, lines 10-17),

the rotation axis being perpendicular to the rotation axes of the second and third links (see Figure 1, reference L4 and page 15, lines 17-20),

the fourth link and the fifth link are connected to each other by the second coaxial joint for rotation about a rotation axis coaxial with the axis of the fourth link (see Figure 1, references c4, c5 and d4 and page 15, lines 20-26), and

the fifth link and the sixth link are connected to each other by the fourth diagonal joint for rotation about a rotation axis inclined at an angle of 45 degrees relative to the axis of the fifth link (see Figure 1, c5, c6, d6 and L7 and page 15, lines 26-33).

A. Configuration Of The Claimed Articulated Manipulator

An articulated manipulator according to claim 8 includes a plurality of links and a plurality of joints rotatably connecting the adjacent links. See page 12, lines 32-34 of the specification. The links are connected by the joints in a straight arm assembly. See page 12, lines 34-36 of the specification. The joints include coaxial joints and diagonal joints. See page 12, line 36 through page 13, line 1 of the specification. Each coaxial joint connects the adjacent links so as to be turnable about a rotation axis aligned with the respective axes of the adjacent links. See page 13, lines 1-4 of the specification. Each diagonal joint connects the two adjacent links such that one of the two adjacent links is able to make a conical revolution on the diagonal joint about a rotation axis inclined to the respective axes of the two adjacent links. See page 13, lines 4-8 of the specification. The articulated manipulator thus formed by assembling the links, the coaxial joints and the diagonal joints is capable of positioning a terminal device in a three-dimensional space by turning the links so that the articulated manipulator twists and turns like a snake. See page 13, lines 13-19 of the specification. Thus, the articulated manipulator of claim 8 is capable of operating in an environment that has complicated facilities, narrow work paths, or narrow spaces, such as a narrow space between the ceiling and the floor spaced a short distance apart in which mechanics need to work in a crouch position. See page 13, lines 19-25 of the specification.

Figure 1 as depicted below shows an articulated manipulator according to one embodiment of the specification.

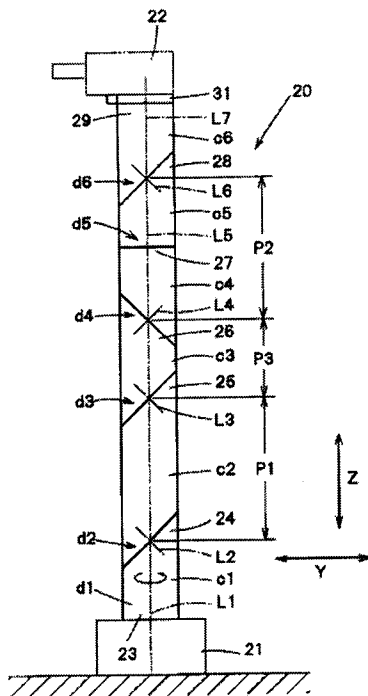


FIG. 1

In Figure 1, an articulated manipulator 20 is a six-degree of freedom articulated manipulator including six links and six joints. See page 14, lines 3-11 of the specification. The six links include first link c1, a second link c2, a third link c3, a fourth link c4, a fifth link c5 and a sixth link c6, and the six joints include a first joint d1, a second joint d2, a third joint d3, a fourth joint d4, a fifth joint d5 and a sixth joint d6, connecting the adjacent links. See page 14, lines 3-11 of the specification. The joints d1 to d6 connect the links c1 to c6 to form an arm assembly. See page 14, lines 11-12 of the specification. The two joints d1 and d5 are coaxial joints, and the four joints d2, d3, d4 and d6 are diagonal joints. See page 14, lines 12-14 of the specification. Each of the diagonal joints d2, d3, d4 and d6 connects the adjacent links such that the two adjacent links are able to revolve relative to each other about a rotation axis inclined at an angle of 45° to the respective axes of the adjacent links. See page 14, lines 14-19 of the specification.

The links c1 to c6 are arranged in series in that order from a base end outward. See page 14, lines 20-21 of the specification. A terminal device 22 is connected to the free end of the sixth link c6. See page 14, lines 21-22 of the specification. The links c1 to c6 can coaxially be extended in a straight structure. See Figure 1 and page 14, lines 22-24 of the specification. Alternatively, different links can be rotated about different joints to form numerous different structures and positions of the terminal device. See, e.g., Figures 3-6.

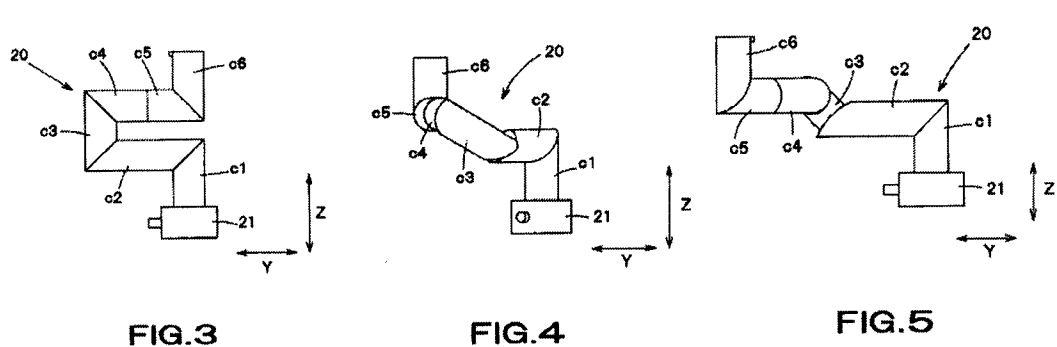
B. Movements Obtained By The Claimed Articulated Manipulator

A space in which the articulated manipulator 20 operates is defined by a coordinate system having an X-axis, a Y-axis and a Z-axis, which are perpendicular to each other. See page 16, lines 10-13 of the specification. In the following description, a longitudinal direction in which the axis of the first link c1 extends is parallel to the Z-axis, and a transverse direction perpendicular to the longitudinal direction is parallel to the Y-axis. See page 16, lines 10-17 of the specification.

The distance P3 along the Z-axis between the diagonal joint d3 connecting the second link c2 and the third link c3, and the diagonal joint d4 connecting the third link c3 and the fourth link c4 is short and hence the arm assembly can be bent substantially in a U-shape so that the sixth link c6 can be brought near to the first link c1 with respect to a direction parallel to the Z-axis. See page 16, lines 25-32 of the specification.

As depicted in Figures 3-5 below, the transverse distance between the first link c1 and the sixth link c6 can be increased and the height, i.e., the size along the Z-axis, of the articulated manipulator 20 can be decreased by turning the third link c3 relative to the second link c2 (Figures 4 and 5), and turning the fourth link c4 relative to the third link c3 in a state where the arm assembly is shaped (Figure 3). See page 18, lines 23-30 of the specification. Thus, the sixth link c6 at a short longitudinal distance from the base 21 can transversely be

moved along the Y-axis without changing the orientation of the sixth link c6. See page 18, lines 30-33 of the specification.



The second link c2, the third link c3, the fourth link c4 and the fifth link c5 can coaxially be extended as shown in Figure 6 by turning the third link c3 relative to the second link c2 and turning the fourth link c4 relative to the third link c3 in a state where the arm assembly is shaped as shown in Figures 4 and 5. See page 18, line 34 through page 19, line 3 of the specification. Thus, the sixth link c6 can be moved without changing its orientation to increase the transverse distance along the Y-axis between the sixth link c6 and the base 21. See Figure 6 and page 19, lines 3-6 of the specification.

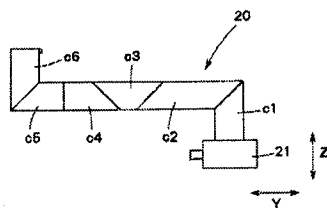
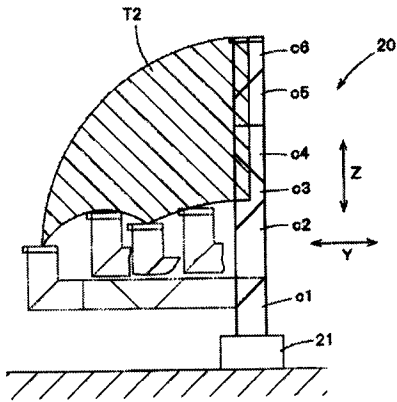


FIG. 6

Figure 7 shows the operational space of the terminal link or the terminal device.

**FIG. 7**

The articulated manipulator 20 formed by connecting the links c1 to c6 by the joints d1 to d6 including the four diagonal joints d2, d3, d4 and d6 has bendable parts and is capable of moving the terminal device 22 in a predetermined orientation in a wide operational space T2. See Figure 7 and page 19, lines 8-13 of the specification.

VI. GROUND OF REJECTION TO BE REVIEWED ON APPEAL

The following grounds of rejection are presented for review:

Claims 8-10 are rejected under 35 U.S.C. §103(a) as allegedly obvious over JP U 04-115592 to Takagi (referred to hereinafter as "Takagi").

VII. ARGUMENT

The January 4, 2008 Office Action concedes that Takagi does not describe the specific arrangement of links and joints recited in claim 8. Specifically, the Office Action acknowledges that Takagi does not describe that the second and third link are connected by a diagonal joint with a rotation axis parallel to the rotation axis of diagonal joint between links one and two, the third and fourth links are connected by a diagonal joint with a perpendicular axis of rotation, the fourth and fifth link are connected by a coaxial joint and the fifth and sixth link are connected by a diagonal joint.

A. Claims 8-10 Would Not Have Been Obvious Over Takagi

1. One Of Ordinary Skill In The Art Would Not Have Modified The Robot Arm Of Takagi To Achieve The Articulated Manipulator Of Claim 8 As Alleged By The Patent Office

The Patent Office alleges that it would have been obvious to have arranged the links of Takagi in the specific order recited in claim 8, since rearranging parts allegedly involves only routine skill in the art.

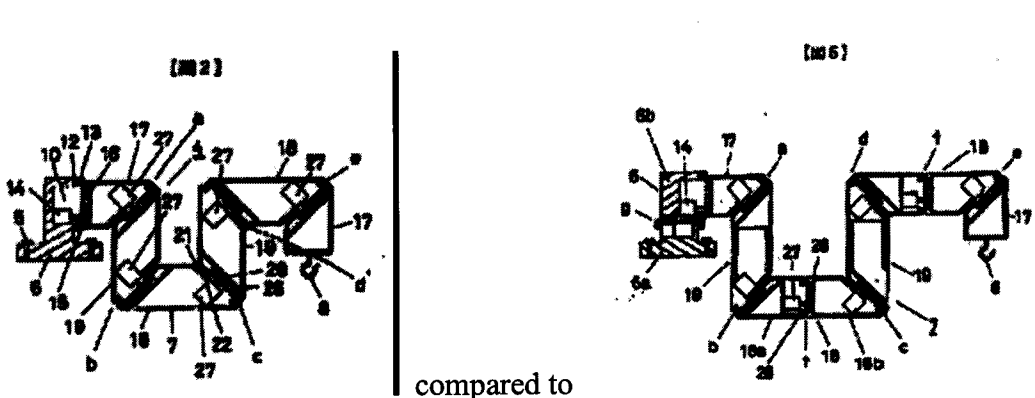
a. One Of Ordinary Skill Would Not Have Rearranged The Robot Arm Of Takagi As Alleged By The Patent Office

One of ordinary skill in the art would not have rearranged the robot arm parts described in Takagi to have achieved the articulated manipulator of claim 8 as alleged by the Patent Office. The Patent Office has alleged that one of ordinary skill in the art would have rearranged the links and joints of the robot arm in Takagi to arrive at the articulated manipulator of claim 8 because links and joints are known. Appellants disagree. Just because links and joints in a robot arm are known does not render any robot arm having links and joints, regardless of arrangement, unpatentable, as apparently alleged by the Patent Office.

Further, "[t]he mere fact that a worker in the art could rearrange the parts of the reference device to meet the terms of the claims on appeal is not by itself sufficient to support a finding of obviousness. The prior art must provide a motivation or reason for the worker in the art, without the benefit of appellant's specification, to make the necessary changes in the reference device (emphasis added)." *Ex parte Chicago Rawhide Mfg. Co.*, 223 USPQ 351, 353 (Bd. Pat. App. & Inter. 1984).

As discussed in more detail below, the specific combination of features recited in claim 8 results in a larger work angle and improved control of the claimed articulated manipulator. Takagi does not describe the specific combination of links and joints recited in claim 8. One of ordinary skill would have had no reason or rationale to have made the necessary changes in the robot arm of Takagi, to arrive at the articulated manipulator of claim 8.

As evidenced by the various figures of Takagi, Takagi's robot arm is capable of a limited specific range of motion. In fact, it appears that when Takagi desires a different range of motion, Takagi must add at least one additional link and/or joint. For example, compare Figures 2 and 5 of Takagi, where Takagi includes additional links and joints in order to modify the motion of the robot arm described therein.



Thus, Takagi generally describes that in order to modify the robot arm of his invention, links and/or joints must be added. Nothing in Takagi describes modifying the

robot arm therein by rearranging the order of links and/or joints. As such, contrary to *Ex parte Chicago Rawhide Mfg. Co.*, nothing in Takagi provides a reason for one of ordinary skill in the art to have modified the robot arm of Takagi as alleged by the Patent Office.

The mere allegation that links and joints are known and therefore all arrangements thereof in a robotic arm are obvious lacks merit under the above-discussed precedential case law.

Further, it would not have been obvious to try rearranging the links and joints of Takagi to arrive at the articulated manipulator claimed in claim 8. "The rationale to support a conclusion that the claim would have been obvious is that 'a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely that the product [was] not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under §103 (emphasis added).'" See MPEP 2143 citing *KSR International Co. V. Teleflex Inc.*, 550 U.S. ___, ___ (2007).

Rearranging the robot arm of Takagi as alleged by the Patent Office has an infinite number of possibilities for rearrangement. Specifically, according to the Patent Office's allegations, any number of links could be added or removed, any number of joints could be added or removed, different joints could be substituted (coaxial versus angled), etc. Considering the number of possibilities for rearrangement as alleged by the Patent Office, there are an infinite number of possible rearrangements. Thus, it would not have been obvious for one of ordinary skill in the art to have tried the specific rearrangement necessary to have achieved the claimed articulated manipulator.

For at least the foregoing reasons, nothing in Takagi would have led one of ordinary skill in the art to have modified the robot arm described therein as alleged by the Patent Office to have achieved the articulated manipulator recited in claim 8.

**b. Improved Work Angle And Control Achieved By
The Configuration Of The Articulated Manipulator
In Claim 8 Is Not Described Or Achieved By Takagi**

The combination of features recited in claim 8 allows for larger work angle and unexpected control of the positioning and orientation of the terminal portion of the sixth link. Takagi does not describe the specific relationship of links and joints recited in claim 8, or the possible advantageous orientations achievable by the links and joints.

As demonstrated in Figure 7 of the present specification, the specific relationship between the recited links and joints results in an advantageous work angle of the articulated manipulator that is larger than in conventional designs. For example, compare Figure 7 (claimed articulated manipulator) and Figure 14 (conventional design).

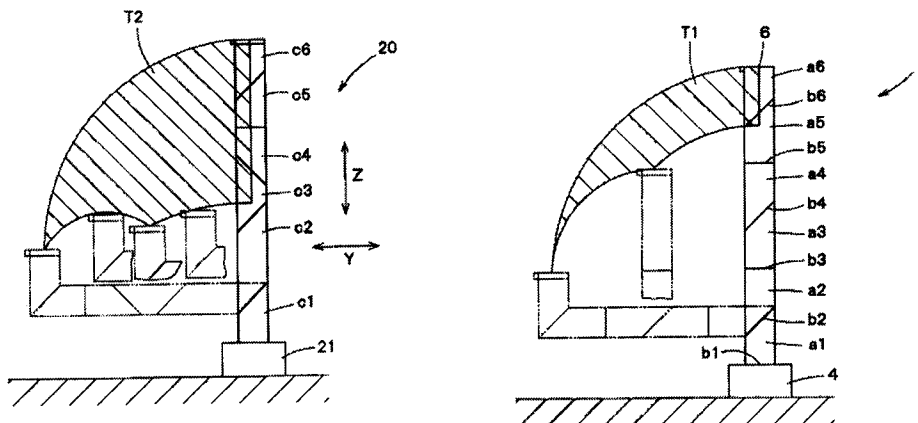


FIG. 7

versus

FIG. 14

For a snake-type robot, like the articulated manipulator of claim 8, it is recognized that many degrees of freedom achieved by an increased number of joints are necessary to obtain a snake-type robot capable of moving in a clever and handy manner. However, when the number of joints increases, it becomes more difficult to control an articulated manipulator. From this description, it becomes apparent that the ability of the articulated manipulator to have an increased freedom of motion requires an increased number of joints,

while the ease of controlling such an articulated manipulator requires a decreased number of joints.

The articulated manipulator of claim 8 addresses the contradiction that occurs between the ability of the articulated manipulator to both (1) have an increased freedom of motion, and (2) be easily controlled. This is achieved by, for example, the fourth link and the fifth link being connected by a second coaxial joint, and thus only the fifth and sixth links need to be moved in order to change the orientation of the sixth link with respect to the first and the second axes. This feature allows the sixth link to be set at a desired position in a desired orientation without turning the first to the fourth links through large angles.

Takagi does not have, and does not render obvious, this second coaxial joint between the fourth link and the fifth link.

Further, the specific combination of features recited in claim 8 creates a triaxial intersection point among the rotational axis of the coaxial joint between the fourth and fifth links, the diagonal link between the fifth and sixth link, and the terminal portion of the sixth link (see Figure 3). For example, the axis, or the line perpendicular to the lines indicating the joints in Figure 3, intersect at a common point.

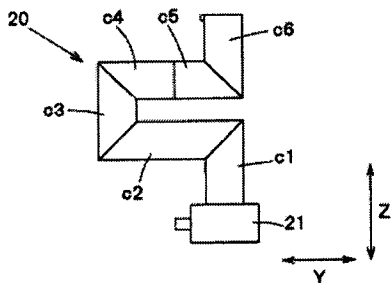
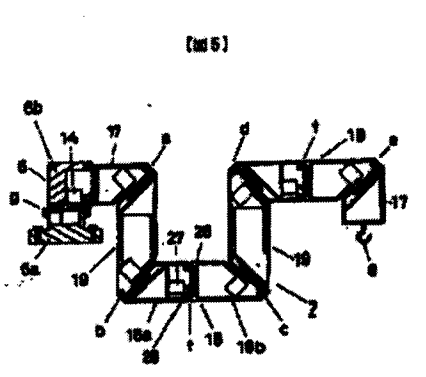


FIG. 3

This triaxial intersection point allows the terminal device to move along a predetermined channel and solves the problem of needing to determine inverse conversions

for calculation of rotational angles of links based on the position and orientation of a terminal device.

In Takagi, for example, Figure 5, as shown below, reveals that the axes of any alleged fourth, fifth and sixth links do not share a common triaxial intersection point.



Thus, Takagi cannot achieve the benefit of the sixth link being set at a desired position in a desired orientation.

Because Takagi lacks the coaxial joint between the fourth and fifth links, the diagonal link between the fifth and sixth link, and the terminal portion of the sixth link, the robot arm of Takagi cannot achieve the triaxial intersection point. Thus, the specific relationship between the links and joints in the articulated manipulator of claim 8 is clearly not obvious from Takagi.

c. Modifying The Manipulator Of Takagi As Alleged By The Patent Office Would Have Modified The Operation Of The Manipulator Of Takagi

In *In re Japikse*, 181 F.2d 1019, 86 USPQ 70 (CCPA 1950), claims to a hydraulic power press which read on the prior art except with regard to the position of the starting switch were held unpatentable because shifting the position of the starting switch would not have modified the operation of the device. See also *In re Kuhle*, 526 F.2d 553, 188 USPQ 7 (CCPA 1975) (the particular placement of a contact in a conductivity measuring device was held to be an obvious matter of design choice). The facts of *Japikse*, however, do not match

those of the current rejection. In particular, the specific arrangement and combination of features recited in claim 8 would have modified the operation of the Takagi device.

If the links and joints of Takagi were rearranged as alleged by the Patent Office, the operation of Takagi would have clearly been altered because Takagi does not describe the Figure 3 or triaxial configuration. Without such configurations, Takagi has a different operation than an articulated arm having such configurations.

Modifying Takagi in the manner suggested by the Patent would thus have modified the operation of the Takagi device at least because Takagi cannot achieve the Figure 3 orientation and because Takagi lacks the triaxial intersection point, achieved by the relationship between the links and joints of the present claims. For example, an examination of Figure 5, as shown above, of Takagi reveals that the axes of any alleged fourth, fifth and sixth links do not share a common triaxial intersection point. Thus, Takagi cannot achieve the benefit of the sixth link being set at a desired position in a desired orientation.

As such, contrary to the Patent Office's allegations, rearranging the joints and links of Takagi would have modified the operation of the robot arm described therein.

For at least the foregoing reasons, it is unreasonable to assert that the specific arrangement and combination of features recited in claim 8 could have been arrived at through mere rearrangement of the parts disclosed in Takagi under the precedent of *Japikse*, or any other identified precedent.

2. It Is Not Appropriate To Rely Solely On Case Law As The Rationale For Obviousness When Applicant Has Demonstrated Criticality of a Specific Limitation

One of ordinary skill in the art would not have been motivated to have modified the structure of Takagi to have achieved the specifically recited arrangement and combination of features recited in claim 8. MPEP §2144.04 states "if the applicant has demonstrated the criticality of a specific limitation, it would not be appropriate to rely solely on case law as the rationale to support an obviousness rejection."

Appellants submit that the critical relationship between the links and joints recited in claim 8 results in a configuration not described or possible in the articulated manipulator of Takagi. Specifically, the Figure 3 configuration and the triaxial intersection point (described in detail above) achievable via the recited relationship among the links and joints demonstrate the criticality of the specific relationships between the links and joints recited in claim 8.

For the foregoing reasons, Appellants have demonstrated criticality of a specific limitation, i.e., the relationship between the claimed links and joints, and thus the Patent Office's sole reliance on case law (*In re Japikse*) as the rationale to support an obviousness rejection is not proper.

3. Claims 9 And 10

Claims 9 and 10 are not described, nor is any reason or rationale given, by the applied reference for (1) the second link consisting of two sublinks connected for rotation about their axes (claim 9), and (2) the sixth link being provided with a twist unit for connecting a predetermined terminal device to the sixth link so as to be rotatable about a rotation axis aligned with the axis of the sixth link (claim 10).

4. Conclusion

For at least the foregoing reasons, claims 8-10 are patentable over the disclosure of Takagi.

VIII. CONCLUSION

For all of the reasons discussed above, it is respectfully submitted that the rejections are in error and that claims 8-10 are in condition for allowance. For all of the above reasons, Appellants respectfully request this Honorable Board to reverse the rejections of claims 8-10.

Respectfully submitted,



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APPENDIX A - CLAIMS APPENDIX

CLAIMS INVOLVED IN THE APPEAL:

8. An articulated manipulator comprising:
 - a base;
 - first to sixth links arranged in series on the base; and
 - a plurality of joints rotatably connecting the base and the first link, and the two adjacent links out of the first to sixth links,

wherein, the joints include first and second coaxial joints and first to fourth diagonal joints,

the first link is connected to the base by the first coaxial joint for rotation about a rotation axis coaxial with an axis of the first link,

the first link and the second link are connected to each other by the first diagonal joint for rotation about a rotation axis inclined at an angle of 45 degrees relative to the first axis of the first link,

the second link and the third link are connected to each other by the second diagonal joint for rotation about a rotation axis inclined at an angle of 45 degrees relative to the axis of the second link, the rotation axis being parallel to the rotation axes of the first and second links,

the third link and the fourth link are connected to each other by the third diagonal joint for rotation about a rotation axis inclined at an angle of 45 degrees relative to the axis of the third link, the rotation axis being perpendicular to the rotation axes of the second and third links,

the fourth link and the fifth link are connected to each other by the second coaxial joint for rotation about a rotation axis coaxial with the axis of the fourth link, and

the fifth link and the sixth link are connected to each other by the fourth diagonal joint for rotation about a rotation axis inclined at an angle of 45 degrees relative to the axis of the fifth link.

9. The articulated manipulator according to claim 8, wherein the second link consists of two sublinks connected for rotation about their axes.

10. The articulated manipulator according to claim 8, wherein the sixth link is provided with a twist unit for connecting a predetermined terminal device to the sixth link so as to be rotatable about a rotation axis aligned with the axis of the sixth link.

APPENDIX B - EVIDENCE APPENDIX

NONE

APPENDIX C - RELATED PROCEEDINGS APPENDIX

NONE